JC14 Rec'd PCT/PTO 24 OCT 2001

FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)
112740-333	09/980511

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE00/01248	20 April 2000	27 April 1999

TITLE OF INVENTION
MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

APPLICANT(S) FOR DO/EO/US
Volker Detering et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include itens (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☒ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.
8. ☒ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☒ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☐ Other items or information:

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/980511	PCT/DE00/01248	112740-333

24. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :

		CALCULATIONS PTO USE ONLY
☐	Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1040.00**
☒	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**
☐	International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$740.00**
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$710.00**
☐	International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**
	ENTER APPROPRIATE BASIC FEE AMOUNT =	**$890.00**
	Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).	**$0.00**

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	12 - 20 =	0	x $18.00	**$0.00**	
Independent claims	1 - 3 =	0	x $84.00	**$0.00**	
Multiple Dependent Claims **(check if applicable)**.			☐	**$0.00**	
	TOTAL OF ABOVE CALCULATIONS =			**$890.00**	
☐	Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.			**$0.00**	
	SUBTOTAL =			**$890.00**	
	Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +			**$0.00**	
	TOTAL NATIONAL FEE =			**$890.00**	
☐	Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			**$0.00**	
	TOTAL FEES ENCLOSED =			**$890.00**	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$890.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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REGISTRATION NUMBER

October 24, 2001
DATE

09/980511
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IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANTS: Volker Detering et al. DOCKET NO: 112740-333

SERIAL NO: GROUP ART UNIT:

EXAMINER:

INTERNATIONAL APPLICATION NO: PCT/DE00/01248

INTERNATIONAL FILING DATE: 20 April 2000

INVENTION: MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In the Specification:

Please replace the Specification of the present application, including the Abstract, with the following Substitute Specification:

SPECIFICATION

TITLE OF THE INVENTION

MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

BACKGROUND OF THE INVENTION

In radio communication systems, messages (for example, voice, image information or other data) are transmitted with the aid of electromagnetic waves. The electromagnetic waves are radiated by antennas and the carrier frequencies are within the frequency band provided for the respective system.

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for transmitting/receiving capability in different frequency bands. For this reason, antennas are needed which can be used in a number of frequency bands.

The demanded coverage of the greatest possible frequency range or, respectively, a number of frequency bands cannot be ensured via conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a function of frequency. This results in a greatly varying antenna gain so that the antenna cannot be used in certain frequency ranges.

For this reason, antenna systems which consist of a number of antennas, each of which covers a certain frequency range, previously have been used for solving this problem.

The disadvantageous factor in such antenna systems is, on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which is variable and which also has the ability to adjust the antenna length and to detect the field strength of a received signal. Furthermore, the detection portion is connected to a control device which, in dependence on the field strength, generates a control signal which varies the antenna length via the adjusting portion until an optimum in the field strength is achieved.

An object to which the present invention is directed is to develop a mobile radio transceiver device in such a manner that it ensures a uniform stable antenna gain while covering a large frequency range.

SUMMARY OF THE INVENTION

The mobile radio transceiver device according to the present invention, therefore, includes:

- an antenna, the length of which can be changed and which is provided for transmitting and receiving radio signals of different frequencies or, respectively, the corresponding wavelengths within a large frequency range;
- a part (facility) for adjusting the antenna length;
- a part for detecting at least one physical input variable representing a function of the antenna length; and
- a control device which reads in at least one input variable and generates, in dependence on this input variable, at least one output signal (control signal) by which the part for adjusting the antenna length is driven, until the antenna length is adjusted to one quarter of the wavelength by the adjusting part.

An advantage of the mobile radio transceiver device according to the present invention is a stable antenna gain which is ensured by matching the antenna length to a quarter of the wavelength of the current frequency independently of the magnitude of the frequency range within which the mobile radio transceiver device is used.

An advantage of one embodiment of the present invention is the detection and the directed transmitting power of the radio signal which provide for simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

An advantage of a further embodiment is the detection and conditioning, required for digital signal processing, of the antenna impedance which provides for a simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

An advantage of yet another embodiment is the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention.

An advantage of one more embodiment is the possibility to be able to use materials which do not need to exhibit any special rigidity but only high resistance to tearing and flexibility for the wire for telescoping the antenna in and out.

Advantages of further embodiments are the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention and the greater attraction for the purchaser or user by hiding the change in antenna length via an electrically nonconductive hollow body.

An advantage of another embodiment is the implementation of a simple device for adjusting the antenna length, which only needs a control signal.

An advantage of yet another embodiment is the implementation of a simple adjusting part for the antenna length which only needs a control signal, the adjustment taking place in defined steps (increments).

Advantages of other embodiments are flexibility and the possibility for updating the implementation of the control which is made possible by using (control) software, and the possibility of using preexisting processors for controlling the mobile radio transceiver device according to the present invention by using additional software or adapting the existing software.

Yet additional advantages are obtained in an embodiment such as the simple and advantageous implementation of the control unit and the possibility of implementing this switching network as integrated circuit in an expansion chip.

The advantages of a further embodiment are the advantageous material properties - high flexibility with high rigidity - of nylon.

An advantage of one further embodiment is that it makes possible to use the mobile radio transceiver device in a frequency range in which the ratio between the highest frequency and the lowest frequency is at least 1.5 octaves.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

Figure 1 shows a mobile radio transceiver device with a telescopic antenna which can be telescoped in and out via a controlled electric motor.

Figure 2 shows a mobile radio transceiver device with a wire antenna which can be telescoped in and out - guided by a hollow body – via an electric motor.

Figure 3 shows a mobile radio transceiver device with adjustment of the antenna length which depends on the upward directed and/or downward directed transmitting power.

Figure 4 shows a mobile radio transceiver device with an adjustment of the antenna length which depends on the antenna impedance.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{min} from the point of view of radio engineering of the telescopic antenna ANT1 being determined by the length of an outermost telescopic segment and a maximum effective antenna length l_{max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an electrically nonconductive wire D1, for example a nylon wire, is attached to its point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the characteristics described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{max} of the telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now additionally only needs to exhibit sufficient (tearing) strength and flexibility.

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example, as a stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts the rotation of the coil former SP1 into a straight-line movement and, thus, enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) μP, the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit μP.

The control unit μP controls the electric motor VM via the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency. The control unit μP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The core former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves. Otherwise, the case may occur that the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT}. This value of

antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case, but an objective of the present invention is not achieved at this value of antenna length l_{ANT}. Ending of the control operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit μP receives the input variable EG, which may be conditioned, from part EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit μP by this part (compare Figures 3 and 4).

As an alternative, the part EFM also detects a number of physical input variables EG and may condition these before they are forwarded to the control unit μP, the control unit μP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully telescoped wire D2.

The electrically conductive wire D2 is guided by an electrically nonconductive rotationally symmetric hollow body HK which is closed at one end, during retraction and telescoping out.

The minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering of the wire antenna ANT2 is obtained from the diameter of the coil former SP2 and the distance between coil former SP2 and the open end of the hollow body HK through which the electrically conductive wire D2 must pass. The

maximum effective antenna length $l_{ANT,max}$ from the point of view of radio engineering is obtained from the diameter of the coil former SP2 and the distance between the coil former SP2 and the closed end of the hollow body HK through which the electrically conductive wire D2 must pass.

The antenna length l_{ANT} is controlled, for example, by the components known from Figure 1:

Part EFM for detecting and conditioning physical input variables EG depending on the antenna length l_{ANT}; control unit μP for evaluating the input variables EG and generating the corresponding control signal U_{ST} for driving the electric motor VM which correspondingly rotates the coil former SP2 in one direction; and the wire D2 guided through the hollow body HK converting the rotational movement of the coil former SP2 into a straight-line movement.

The hollow body HK additionally fulfills the function of hiding the wire antenna ANT2; i.e., the movement of the wire D2 resulting from the antenna length l_{ANT} being controlled. It is not visible to the user, which increases the attraction of the mobile radio transceiver device SE. In addition, the hollow body HK protects the wire D2 against deformations.

The antenna connection of the wire antenna D2 is implemented by a sliding contact SK which is in contact with the electrically conductive coil former SP2 and, as an alternative, the sliding contact SK can also contact the electrically conductive wire D2 wound on to the coil former SP2.

Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting part VM for adjusting the antenna length l_{ANT}, the control unit μP and part EFM for detecting a transmit signal SIG which is generated by a radio section FT.

For this purpose, the part EFM exhibits a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a first digital signal P_V'' by a first analog/digital converter AD1. The return transmit

power P_R is rectified by a second rectifier G2 and the rectified return transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

The digital signals P_V'', P_R'' are present as input signal at the control unit μP, the control unit μP being constructed, for example, as (micro)processor with associated software. With the signals P_V'', P_R'' present, the processor μP checks whether the signals P_V'', P_R'' have, in each case, reached an ideal value P_R''=0 or P_R''=$P_{R,min}$'' and P_V''=$P_{V,max}$''.

If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor μP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals P_V'', P_R'' present at the processor which are changed by this process are checked by the processor μP with respect to the ideal values to be reached.

If the values of the signals P_V", P_R" have deteriorated with regard to reaching the ideal values, the direction of rotation of the part (VM) for adjusting the antenna length l_{ANT} is changed. This is achieved, for example, by reversing the sign of the signal U_{ST}.

Following the determination of the correct direction, the signal U_{ST} is generated until the input signals P_V", P_R" have reached their ideal values.

As an alternative, any one of the two variables - forward transmit power P_V and return transmit power P_R - can also be used as control variable for this servo loop; i.e., detected by the part EFM and checked by the processor μP whether it has reached the ideal values (minimum or no return transmit power or maximum forward transmit power).

As an alternative to using an additional processor μP, it would be conceivable that pre-existing processors are updated by suitable control software in order to be able to perform this control operation.

If an additional processor μP is used, it would also be conceivable to integrate the part EFM in the processor μP.

The radio transceiver device SE shown in Figure 4 again exhibits the part EFM for detecting the current antenna impedance Z_{ANT} of the antenna ANT.

For this purpose, the part EFM is constructed as a Wheatstone resistance measuring bridge, with a reference resistor R0=50Ω, two resistors R1, R2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating noise; for example, implemented by a diode connected to a direct-voltage source. A current bridge voltage U_{BR} present at terminals KL is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' via an analog/digital converter AD3.

The signal U_{BR}'' is forwarded to a control unit μP which, when a signal is present, starts to control the antenna length l_{ANT}, which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} (i.e., whether the antenna is to be retracted or telescoped out) being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit μP as switchgear and to implement it as an integrated circuit in a special expansion chip.

A first exemplary embodiment of the present invention is obtained by combining Figures 1 and 3, a second exemplary embodiment is obtained from Figures 1 and 4, a third exemplary embodiment is obtained from Figures 2 and 3 and a fourth one from Figures 2 and 4.

The four exemplary embodiments only represent a part of the embodiments possible pursuant to the present invention. Thus, an expert active in this field is capable of creating a multiplicity of further embodiments via advantageous modifications without changing the character (nature) of the present invention. These embodiments are also intended to be covered by the present invention.

Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

ABSTRACT OF THE DISCLOSURE

To implement a transmitting/receiving capability in different frequency ranges via radio transceiver devices which guarantee a uniformly stable antenna gain, the radio transceiver devices are equipped with an antenna, the length of which is adjustable, the antenna length being changed by an adjusting part controlled by a control device. The control device controls the adjusting part in dependence on physical input variables representing the antenna length until the antenna length corresponds to one quarter of the wavelength.

In the claims:

On page 12, cancel line 1, and substitute the following left-hand justified heading therefor:

CLAIMS

Please cancel claims 1-12, without prejudice, and substitute the following claims therefor:

13. A mobile radio transceiver device, comprising:

an antenna for transmitting radio signals of different wavelengths, the length of the antenna being variable;

an adjusting part for adjusting the antenna length;

a detection part for detecting at least one physical input variable representing a function of the antenna length; and

a control device connected to the detection part for controlling the adjusting part via at least one control signal in dependence on the at least physical input variable until the antenna length is adjusted to one quarter of the wavelength via the adjusting part, the control device adjusting the antenna length to a minimum value at a beginning of the adjustment of the antenna length.

14. A mobile radio transceiver device as claimed in claim 13, wherein the detection part further comprises:

a directional coupler for measuring at least one of a forward transmit power and a return transmit power of a transmit signal;

at least one rectifier for rectifying values of the forward transmit power and the return transmit power measured by the directional coupler, the at least one rectifier generating, respectively, a rectified forward transmit power and a rectified return transmit power; and

at least one A/D converter for digital conversion of the rectified values of the forward transmit power and the return transmit power, the at least one A/D converter generating, respectively, a digitally converted forward transmit power and a digitally converted return transmit power;

wherein the control device reads in the digitally converted values of the forward transmit power and the return transmit power as input signals and generates the control signal dependent thereupon until, respectively, a value of the digitally converted forward transmit power is at a maximum and a value of the digitally converted return transmit power is at a minimum.

15. A mobile radio transceiver device as claimed in claim 13, wherein the detection part further comprises:

a Wheatstone measuring bridge which generates a bridge voltage which is proportional to an impedance of the antenna;

a noise generator used as an input signal source for the Wheatstone measuring bridge;

a rectifier for rectifying the bridge voltage of the Wheatstone measuring bridge to generate a rectified bridge voltage; and

an A/D converter for digital conversion of the rectified value of the bridge voltage of the Wheatstone measuring bridge, the A/D converter generating a digitally converted bridge voltage;

wherein the control unit, which reads in the digitally converted value of the bridge voltage of the Wheatstone measuring bridge as input signal, generates a control signal dependent thereupon until the Wheatstone measuring bridge is calibrated.

16. The mobile radio transceiver device as claimed in Claim 13, wherein the antenna is a telescopic antenna to which an electrically non-conductive wire is attached on an inside surface at an antenna point, the adjusting part exhibits an electrically non-conductive coil former on which the electrically non-conductive wire is wound, and the electrically non-conductive wire converts rotational movement of the coil former into a straight-line movement in order to retract and telescope out the telescopic segments of the telescopic antenna.

17. A mobile radio transceiver device as claimed in Claim 16, wherein the telescopic antenna further comprises:

a spring, for supporting the wire for telescoping out the telescopic antenna, which presses all telescopic segments of the telescopic antenna outward so that the telescopic antenna is completely telescoped out.

18. A mobile radio transceiver device as claimed in Claim 13, wherein the the adjusting part includes an electrically conductive coil former on which an electrically conductive wire, electrically conductively connected to the coil former, is wound, the electrically conductive wire converts a rotational movement of the coil former, guided by an electrically non-conductive hollow body, into a straight-line movement, and the antenna is constructed as a wire antenna which is composed of the telescoped-out wire and the electrically conductively connected coil former , a connection of the wire antenna being achieved via an electrically conductive sliding contact which contacts the coil former at a base.

19. A mobile radio transceiver device as claimed in Claim 13, wherein the adjusting part includes an electrically conductive coil former on which an electrically conductive wire, electrically conductively connected to the coil former, is wound, the electrically conductive wire converts a rotational movement of the coil former, guided by an electrically non-conductive hollow body, into a straight-line movement, and the antenna is constructed as wire antenna which is composed of the telescoped-out wire and the electrically conductively connected coil former, a connection of the wire antenna being achieved via an electrically conductive sliding contact which contacts the wire wound onto the coil former at a base.

20. A mobile radio transceiver device as claimed in Claim 13, wherein the adjusting device is an electric motor.

21. A mobile radio transceiver device as claimed in Claim 20, wherein the electric motor is a stepping motor.

22. A mobile radio transceiver device as claimed in Claim 13, wherein the control unit is a processor with software designed for generating the at least one control signal.

23. A mobile radio transceiver device as claimed in Claim 13, wherein the control unit is switchgear.

24. A mobile radio transceiver device as claimed in Claim 16, wherein the electrically non-conductive wire is a nylon wire.

REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification, which includes the Abstract, in order to conform the specification to the requirements of United States Patent Practice. No new matter is

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added thereby. Attached hereto is a marked-up version of the changes made to the specification by the present amendment. The attached page is captioned "**Version With Markings To Show Changes Made".**

In addition, the present amendment cancels original claims 1-12 in favor of new claims 13-24. Claims 13-24 have been presented solely because the revisions by crossing out and underlining which would have been necessary in claims 1-12 in order to present those claims in accordance with preferred United States Patent Practice would have been too extensive, and thus would have been too burdensome. The present amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§103, 102, 103 or 112. Indeed, the cancellation of claims 1-12 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-12.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

(Reg. No. 39,056)

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Attorneys for Applicant

Version With Markings to Show Changes Made

~~Description~~

SPECIFICATION

TITLE OF THE INVENTION

~~Mobile radio transceiver device with tunable antenna~~

MOBILE RADIO TRANSCEIVER DEVICE WITH TUNABLE ANTENNA

BACKGROUND OF THE INVENTION

In radio communication systems, messages (for example, voice, image information or other data) are transmitted with the aid of electromagnetic waves. The electromagnetic waves are radiated by antennas and the carrier frequencies are within the frequency band provided for the respective system.

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for transmitting/receiving capability in different frequency bands. For this reason, antennas are needed which can be used in a number of frequency bands.

The demanded coverage of the greatest possible frequency range or, respectively, a number of frequency bands cannot be ensured ~~by means of~~ via conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a function of frequency~~, which~~. This results in a greatly varying antenna gain so that the antenna cannot be used in certain frequency ranges.

For this reason, antenna systems which consist of a number of antennas, each of which covers a certain frequency range, ~~have~~ previously have been used for solving this problem.

The disadvantageous factor in such antenna systems is, on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which is variable and which also has ~~means for adjusting~~ the ability to adjust the antenna

length and ~~means for detecting~~ to detect the field strength of a received signal. Furthermore, the detection ~~means are~~ portion is connected to a control device which, in dependence on the field strength, generates a control signal which varies the antenna length ~~by means of~~ via the adjusting ~~means~~ portion until an optimum in the field strength is achieved.

~~The~~ An object ~~forming~~ to which the ~~basis of the~~ present invention is directed is to develop a mobile radio transceiver device in such a manner that it ensures a uniform stable antenna gain ~~whilst~~ while covering a large frequency range.

~~This object is achieved by features of claim 1.~~

SUMMARY OF THE INVENTION

The mobile radio transceiver device according to the present invention ~~according to claim 1 exhibits~~, therefore, includes:

- an antenna, the length of which can be changed and which is provided for transmitting and receiving radio signals of different frequencies or, respectively, the corresponding wavelengths within a large frequency range~~,~~;
- a ~~means~~ part (facility) for adjusting the antenna length~~,~~;
- ~~means~~ a part for detecting at least one physical input variable representing a function of the antenna length; and
- a control device ~~connected to the means,~~ which reads in at least one input variable and generates, in dependence on this input variable, at least one output signal (control signal) by ~~means of~~ which the ~~means~~ part for adjusting the antenna length ~~are~~ is driven, until the antenna length is adjusted to one quarter of the wavelength by the adjusting ~~means.~~ part.

~~The essential~~ An advantage of the mobile radio transceiver device according to the present invention is a stable antenna gain which is ensured by matching the antenna length to a quarter of the wavelength of the current frequency

independently of the magnitude of the frequency range within which the mobile radio transceiver device is used.

An ~~essential~~ advantage of ~~the further development according to claim 2~~ one embodiment of the present invention is the detection and the directed transmitting power of the radio signal which provide for simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

An ~~essential~~ advantage of ~~the~~ a further ~~development according to claim 3~~ embodiment is the detection and conditioning, required for digital signal processing, of the antenna impedance which provides for a simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

~~The essential~~ An advantage of ~~the further development according to claim 4~~ yet another embodiment is the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention.

~~The essential~~ An advantage of ~~the further development according to claim 5~~ one more embodiment is the possibility to be able to ~~also~~ use materials which do not need to exhibit any special rigidity but only high resistance to tearing and flexibility for the wire for telescoping the antenna in and out.

Advantages of ~~the further developments according to claim 6 and 7~~ further embodiments are the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the present invention and the greater attraction for the purchaser or user by hiding the change in antenna length ~~by means of~~ via an electrically nonconductive hollow body.

An ~~essential~~ advantage of ~~the further development according to claim 8~~ another embodiment is the implementation of a simple device for adjusting the antenna length, which only needs a control signal.

An ~~essential~~ advantage of ~~the further development according to claim 9~~ yet another embodiment is the implementation of a simple adjusting ~~means~~ part for the antenna length which only ~~need~~ needs a control signal, the adjustment taking place in defined steps (increments).

~~Essential advantages of the further development according to claim 10~~ Advantages of other embodiments are flexibility and the possibility for updating the implementation of the control which is made possible by using (control) software, and the possibility of using preexisting processors for controlling the mobile radio transceiver device according to the present invention by using additional software or adapting the existing software.

~~Essential advantages of the further development according to claim 11 are~~ Yet additional advantages are obtained in an embodiment such as the simple and advantageous implementation of the control unit and the possibility of implementing this switching network as integrated circuit in an expansion chip.

The ~~essential~~ advantages of ~~the~~ a further ~~development according to claim 12~~ embodiment are the advantageous material properties - high flexibility with high rigidity - of nylon.

~~The essential~~ An advantage of ~~the~~ one further ~~development according to claim 13~~ embodiment is that it makes possible to use the mobile radio transceiver device in a frequency range in which the ratio between the highest frequency and the lowest frequency is at least 1.5 octaves.

Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Invention and the Figures.

BRIEF DESCRIPTION OF THE FIGURES

~~Exemplary embodiments of the invention will be explained with reference to the figures 1 to 4, in which:~~

Figure 1 shows a mobile radio transceiver device with a telescopic antenna which can be telescoped in and out ~~by means of~~ via a controlled electric motor~~,~~.

Figure 2 shows a mobile radio transceiver device with a wire antenna which can be telescoped in and out - guided by a hollow body – ~~– by means of~~ via an electric motor~~,~~.

Figure 3 shows a mobile radio transceiver device with adjustment of the antenna length which depends on the upward directed and/or downward directed transmitting power.

Figure 4 shows a mobile radio transceiver device with an adjustment of the antenna length which depends on the antenna impedance.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{min} from the point of view of radio engineering of the telescopic antenna ANT1 being determined by the length of an outermost telescopic segment and a maximum effective antenna length l_{max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an electrically nonconductive wire D1, for example a nylon wire, is attached to its point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the characteristics described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{max} of the telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now additionally only needs to exhibit sufficient (tearing) strength and flexibility.

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example, as a stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts

the rotation of the coil former SP1 into a straight-line movement and, thus, enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) μP, the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit μP.

The control unit μP controls the electric motor VM ~~by means of~~ via the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency. The control unit μP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The core former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves~~, since otherwise~~. Otherwise, the case may occur that the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT}. This value of antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case, but ~~the object~~ an objective of the present invention is not achieved at this value of antenna length l_{ANT}. Ending of the control

operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit µP receives the input variable EG, which may be conditioned, from ~~means~~ part EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit µP by ~~these means~~ this part (compare ~~figure 3~~ Figures 3 and 4).

As an alternative, the ~~means~~ part EFM also ~~detect~~ detects a number of physical input variables EG and may condition these before they are forwarded to the control unit µP, the control unit µP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully telescoped wire D2.

The electrically conductive wire D2 is guided by an electrically nonconductive rotationally symmetric hollow body HK which is closed at one end, during retraction and telescoping out.

The minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering of the wire antenna ANT2 is obtained from the diameter of the coil former SP2 and the distance between coil former SP2 and the open end of the hollow body HK through which the electrically conductive wire D2 must pass. The maximum effective antenna length $l_{ANT,max}$ from the point of view of radio engineering is obtained from the diameter of the coil former SP2 and the distance

between the coil former SP2 and the closed end of the hollow body HK through which the electrically conductive wire D2 must pass.

The antenna length l_{ANT} is controlled, for example, by the components known from ~~figure 1:~~ Figure 1:

~~Means~~ Part EFM for detecting and conditioning physical input variables EG depending on the antenna length l_{ANT}~~,~~; control unit µP for evaluating the input variables EG and generating the corresponding control signal U_{ST} for driving the electric motor VM which correspondingly rotates the coil former SP2 in one direction~~,~~; and the wire D2 guided through the hollow body HK converting the rotational movement of the coil former SP2 into a straight-line movement.

The hollow body HK additionally fulfills the function of hiding the wire antenna ANT2~~,~~; i.e.~~,~~ the movement of the wire D2 resulting from the antenna length l_{ANT} being controlled~~; it.~~ It is not visible to the user, which increases the attraction of the mobile radio transceiver device SE. In addition, the hollow body HK protects the wire D2 against deformations.

The antenna connection of the wire antenna D2 is implemented by a sliding contact SK which is in contact with the electrically conductive coil former SP2 and, as an alternative, the sliding contact SK can also contact the electrically conductive wire D2 wound on to the coil former SP2.

Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting ~~means~~ part VM for adjusting the antenna length l_{ANT}, the control unit µP and ~~means~~ part EFM for detecting a transmit signal SIG which is generated by a radio section FT.

For this purpose, the ~~means~~ part EFM ~~exhibit~~ exhibits a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a first digital signal P_V'' by a first analog/digital converter AD1. The return transmit power P_R is rectified by a second rectifier G2 and the rectified return

transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

The digital signals P_V'', P_R'' are present as input signal at the control unit μP, the control unit μP being constructed, for example, as (micro)processor with associated software. With the signals P_V'', P_R'' present, the processor μP checks whether the signals P_V'', P_R'' have, in each case, reached an ideal value P_R''=0 or P_R''=$P_{R,min}$'' and P_V''=$P_{V,max}$''.

If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor μP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals P_V'', P_R'' present at the processor which are changed by this process are checked by the processor μP with respect to the ideal values to be reached.

If the values of the signals P_V", P_R" have deteriorated with regard to reaching the ideal values, the direction of rotation of the ~~means~~ part (VM) for adjusting the antenna length l_{ANT} is changed. This is achieved, for example, by reversing the sign of the signal U_{ST}.

Following the determination of the correct direction, the signal U_{ST} is generated until the input signals P_V", P_R" have reached their ideal values.

As an alternative, any one of the two variables - forward transmit power P_V and return transmit power P_R - can also be used as control variable for this servo loop, i.e., detected by the ~~means~~ part EFM and checked by the processor μP whether it has reached the ideal values -(minimum or no return transmit power or maximum forward transmit power).

As an alternative to using an additional processor μP, it would be conceivable that pre-existing processors are updated by suitable control software in order to be able to perform this control operation.

If an additional processor μP is used, it would also be conceivable to integrate the ~~means~~ part EFM in the processor μP.

The radio transceiver device SE shown in ~~figure~~ Figure 4 again exhibits the ~~means~~ part EFM for detecting the current antenna impedance Z_{ANT} of the antenna ANT.

For this purpose, the ~~means~~ part EFM ~~are~~ is constructed as a Wheatstone resistance measuring bridge, with a reference resistor R0=50Ω, two resistors R1, R2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating noise~~,~~; for example, implemented by a diode connected to a direct-voltage source. A current bridge voltage U_{BR} present at terminals KL is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' ~~by means of~~ via an analog/digital converter AD3.

The signal U_{BR}'' is forwarded to a control unit µP which, when a signal is present, starts to control the antenna length l_{ANT}, which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} ~~i.e.~~(i.e., whether the antenna is to be retracted or telescoped out-) being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit µP as switchgear and to implement it as an integrated circuit in a special expansion chip.

A first exemplary embodiment of the present invention is obtained by combining ~~figures~~ Figures 1 and 3, a second exemplary embodiment is obtained from ~~figures~~ Figures 1 and 4, a third exemplary embodiment is obtained from ~~figures~~ Figures 2 and 3 and a fourth one from ~~figures~~ Figures 2 and 4.

The ~~said~~ four exemplary embodiments only represent a part of the embodiments possible ~~by means of~~ pursuant to the present invention. Thus, an expert active in this field is capable of creating a multiplicity of further embodiments ~~by means of~~ via advantageous modifications without changing the

character (nature) of the present invention ~~by this means~~. These embodiments are also intended to be covered by the ~~invention.~~ present invention.

~~Patent Claims~~

Indeed, although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.

Docket #: 0-0000-0000

~~Abstract~~

ABSTRACT OF THE DISCLOSURE

~~Mobile radio transceiver device with tuneable antenna~~

To implement a transmitting/receiving capability in different frequency ranges via ~~by means of~~ radio transceiver devices ~~SE~~ which guarantee a uniformly stable antenna gain, the radio transceiver devices ~~SE~~ are equipped with an antenna ~~ANT~~, the length l_{ANT} of which is adjustable, the antenna length l_{ANT} being changed by an ~~means of~~ adjusting part ~~means VM~~ controlled by ~~means of~~ a control device ~~µP~~. The control device ~~µP~~ controls the adjusting part ~~means VM~~ in dependence on physical input variables ~~EG~~ representing the antenna length l_{ANT} until the antenna length l_{ANT} corresponds to one quarter of the wavelength ~~λ~~/.

~~FIGURE 3~~

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Description

Mobile radio transceiver device with tunable antenna

In radio communication systems, messages (for example voice, image information or other data) are transmitted with the aid of electromagnetic waves. The electromagnetic waves are radiated by antennas and the carrier frequencies are within the frequency band provided for the respective system.

Apart from the requirement that the dimensions of the antenna must be limited in mobile radio transceiver devices, there is also increasingly a demand for transmitting/receiving capability in different frequency bands. For this reason, antennas are needed which can be used in a number of frequency bands.

The demanded coverage of the greatest possible frequency range or, respectively, a number of frequency bands cannot be ensured by means of conventional antennas, for example rod-shaped antennas which are used, in particular, in mobile parts, since the impedance of the antenna varies greatly as a function of frequency, which results in a greatly varying antenna gain so that the antenna cannot be used in certain frequency ranges.

For this reason, antenna systems which consist of a number of antennas, each of which covers a certain frequency range, have previously been used for solving this problem.

The disadvantageous factor in such antenna systems is, on the one hand, the increased space requirement and, on the other hand, suboptimal matching of the antennas to the individual frequencies from the respective frequency band.

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From JP A 09 162 620, a radio transceiver device is known which has an antenna for transmitting radio signals of different wavelengths, the length of which is variable and which also has means for adjusting the antenna length and means for detecting the field strength of a received signal. Furthermore, the detection means are connected to a control device which, in dependence on the field strength, generates a control signal which varies the antenna length by means of the adjusting means until an optimum in the field strength is achieved.

The object forming the basis of the invention is to develop a mobile radio transceiver device in such a manner that it ensures a uniform stable antenna gain whilst covering a large frequency range.

This object is achieved by features of claim 1.

The mobile radio transceiver device according to the invention according to claim 1 exhibits

- an antenna, the length of which can be changed and which is provided for transmitting and receiving radio signals of different frequencies or, respectively, the corresponding wavelengths within a large frequency range,
- a means (facility) for adjusting the antenna length,
- means for detecting at least one physical input variable representing a function of the antenna length
- a control device connected to the means, which reads in at least one input variable and generates, in dependence on this input variable, at least one output signal (control signal) by means of which the means for adjusting the antenna

length are driven, until the antenna length is adjusted to one quarter of the wavelength by the adjusting means.

The essential advantage of the mobile radio transceiver device according to the invention is a stable antenna gain which is ensured by matching the antenna length to a quarter of the wavelength of the current frequency independently of the magnitude of the frequency range within which the mobile radio transceiver device is used.

An essential advantage of the further development according to claim 2 is the detection and the

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conditioning, required for digital signal processing, of output and/or downward

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directed transmitting power of the radio signal which provide for simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

An essential advantage of the further development according to claim 3 is the detection and conditioning, required for digital signal processing, of the antenna impedance which provides for a simple detection of when the ideal antenna length (antenna length = wavelength/4) is reached.

The essential advantage of the further development according to claim 4 is the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the invention.

The essential advantage of the further development according to claim 5 is the possibility to be able to also use materials which do not need to exhibit any special rigidity but only high resistance to tearing and flexibility for the wire for telescoping the antenna in and out.

Advantages of the further developments according to claim 6 and 7 are the simple implementation of the length-adjustable antenna necessary for realizing the mobile radio transceiver device according to the invention and the greater attraction for the purchaser or user by hiding the change in antenna length by means of an electrically nonconductive hollow body.

An essential advantage of the further development according to claim 8 is the implementation of a simple device for adjusting the antenna length, which only needs a control signal.

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An essential advantage of the further development according to claim 9 is the implementation of simple adjusting means for the antenna length which only need a control signal, the adjustment taking place in defined steps (increments).

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Essential advantages of the further development according to claim 10 are flexibility and possibility for updating the implementation of the control which is made possible by using (control) software, and the possibility of using preexisting processors for controlling the mobile radio transceiver device according to the invention by using additional software or adapting the existing software.

Essential advantages of the further development according to claim 11 are the simple and advantageous implementation of the control unit and the possibility of implementing this switching network as integrated circuit in an expansion chip.

The essential advantages of the further development according to claim 12 are the advantageous material properties - high flexibility with high rigidity - of nylon.

The essential advantage of the further development according to claim 13 is that it makes possible to use the mobile radio transceiver device in a frequency range in which the ratio between the highest frequency and the lowest frequency is at least 1.5 octaves.

Exemplary embodiments of the invention will be explained with reference to the figures 1 to 4, in which:

Figure 1 shows a mobile radio transceiver device with a telescopic antenna which can be telescoped in and out by means of a controlled electric motor,

Figure 2 shows a mobile radio transceiver device with a wire antenna which can be telescoped in and out - guided by a hollow body - by means of

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an electric motor,

Figure 3 shows a mobile radio transceiver device with adjustment of the antenna length which depends on the upward directed and/or downward directed transmitting power,

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Figure 4 shows a mobile radio transceiver device with an adjustment of the antenna length which depends on the antenna impedance.

Figure 1 shows a mobile radio transceiver device SE with a transmitting/receiving antenna constructed as telescopic antenna ANT1, a minimum effective antenna length l_{min} from the point of view of radio engineering of the telescopic antenna ANT1 being determined by the length of an outermost telescopic segment and a maximum effective antenna length l_{max} from the point of view of radio engineering being determined by the length of the telescopic antenna ANT1 telescoped completely. In the interior of the telescopic antenna ANT1, an electrically nonconductive wire D1, for example a nylon wire, is attached to its point, which is of such a nature that it has sufficient rigidity for telescoping out the telescopic antenna ANT1, has sufficient flexibility to be wound on to an electrically nonconductive coil former SP1 and has sufficient strength for being able to retract the telescopic antenna ANT1.

As an alternative to nylon, other materials having the characteristics described can be used, and if the rigidity of a material used is inadequate, a spring is used which is attached to an innermost telescopic segment and the antenna base inside the telescopic antenna ANT1 and ensures the maximum length l_{max} of the telescopic antenna ANT1 in the relieved state by pressing on the innermost telescopic segment, and the electrically nonconductive wire D1 used now additionally only needs to exhibit sufficient (tearing) strength and flexibility.

The coil former SP1 is rotated forward or backward by an electric motor VM which is constructed, for example,

as stepping motor so that the wire D1 attached to the electrically nonconductive coil former SP1 and to the antenna point converts

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the rotation of the coil former SP1 into a straight-line movement and thus enables the telescopic antenna ANT1 to be retracted or telescoped out. The (step) angle and the direction of rotation are determined by the absolute value, the sign and/or the duration of a voltage (control signal) U_{ST} present at the electric motor VM.

This voltage U_{ST} is a signal (control signal) present at the output of a control unit (microprocessor) µP, the absolute value, sign and/or signal duration of which is dependent on the input variable EG present at the control unit µP.

The control unit µP controls the electric motor VM by means of the signal U_{ST} until the effective antenna length l_{ANT} from the point of view of radio engineering corresponds to one quarter of the wavelength λ of the current transmit frequency. The control unit µP indirectly determines whether the condition $l_{ANT}=\lambda/4$ is met by evaluating the input variable EG, the input variable EG indicating that the condition $l_{ANT}=\lambda/4$ is met when an ideal value is reached. The core former SP1 is initially driven in such a manner that it is always rotated in a predetermined direction at the beginning of the control operation (default). If the evaluation shows that the input variable EG is moving away from the ideal value, the direction of rotation is changed and the electric motor VM is driven until the input variable EG has reached the ideal value.

As an alternative, it is possible to begin the control operation additionally from a defined starting point, for example always from the retracted state of the telescopic antenna and, therefore, first to secure this starting point at the beginning of the control operation. This procedure is required particularly when

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the mobile radio transceiver device SE is used in a very wide frequency range in which the ratio of the maximum frequency to the lowest frequency is at least 1.5 octaves, since otherwise the case may occur that the controlling of the antenna length l_{ANT} is ended at $l_{ANT}=3\lambda/4$, depending on the current antenna length l_{ANT}. This value

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of antenna length l_{ANT} is unwanted since the input variable EG also reaches the ideal value for this case but the object of the invention is not achieved at this value of antenna length l_{ANT}. Ending of the control operation of the antenna length l_{ANT} when this value is reached can be prevented if, for example, suitable control software allows the control of the antenna length l_{ANT} to begin at the minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering, which ensures that the input variable EG always ensures that the condition $l_{ANT}=\lambda/4$ is met when the ideal value is reached.

The control unit µP receives the input variable EG, which may be conditioned, from means EFM for detecting physical input variables EG which depend on an antenna length l_{ANT} and which may be transformed into a form necessary for the control unit µP by these means (compare figure 3 and 4).

As an alternative, the means EFM also detect a number of physical input variables EG and may condition these before they are forwarded to the control unit µP, the control unit µP correspondingly checking a number of input variables before they have reached an ideal value.

The antenna connection of the telescopic antenna ANT1 is located at the outermost telescopic segment of the antenna.

Figure 2 shows a wire antenna ANT2, the effective length l_{ANT} of which from the point of view of radio engineering results from the diameter of an electrically conductive coil former SP2 on which an electrically conductive wire D2 is wound in an electrically conductively connected manner, and the length of the fully

telescoped wire D2.

The electrically conductive wire D2 is guided by an electrically nonconductive rotationally symmetric hollow body HK which is closed at one end, during retraction and telescoping out.

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The minimum effective antenna length $l_{ANT,min}$ from the point of view of radio engineering of the wire antenna ANT2 is obtained from the diameter of the coil former SP2 and the distance between coil former SP2 and the open end of the hollow body HK through which the electrically conductive wire D2 must pass. The maximum effective antenna length $l_{ANT,max}$ from the point of view of radio engineering is obtained from the diameter of the coil former SP2 and the distance between the coil former SP2 and the closed end of the hollow body HK through which the electrically conductive wire D2 must pass.

The antenna length l_{ANT} is controlled, for example, by the components known from figure 1:

Means EFM for detecting and conditioning physical input variables EG depending on the antenna length l_{ANT}, control unit μP for evaluating the input variables EG and generating the corresponding control signal U_{ST} for driving the electric motor VM which correspondingly rotates the coil former SP2 in one direction, the wire D2 guided through the hollow body HK converting the rotational movement of the coil former SP2 into a straight-line movement.

The hollow body HK additionally fulfills the function of hiding the wire antenna ANT2, i.e. the movement of the wire D2 resulting from the antenna length l_{ANT} being controlled; it is not visible to the user, which increases the attraction of the mobile radio transceiver device SE. In addition, the hollow body HK protects the wire D2 against deformations.

The antenna connection of the wire antenna D2 is implemented by a sliding contact SK which is in contact with the electrically conductive coil former SP2 and,

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as an alternative, the sliding contact SK can also contact the electrically conductive wire D2 wound on to the coil former SP2.

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Figure 3 diagrammatically shows a radio transceiver device SE with an arbitrary antenna ANT, the length l_{ANT} of which can be changed, the adjusting means VM for adjusting the antenna length l_{ANT}, the control unit µP and means EFM for detecting a transmit signal SIG which is generated by a radio section FT.

For this purpose, the means EFM exhibit a directional coupler RK which couples a forward transmit power P_V and a return transmit power P_R out of the transmit signal SIG. The forward transmit power P_V is then first rectified by a first rectifier G1 and the rectified forward transmit power P_V' is then converted into a first digital signal P_V'' by a first analog/digital converter AD1. The return transmit power P_R is rectified by a second rectifier G2 and the rectified return transmit power P_R' is then converted into a second digital signal P_R'' by a second analog/digital converter AD2.

The digital signals P_V'', P_R'' are present as input signal at the control unit µP, the control unit µP being constructed, for example, as (micro)processor with associated software. With the signals P_V'', P_R'' present, the processor µP checks whether the signals P_V'', P_R'' have in each case reached an ideal value $P_R''=0$ or $P_R''=P_{R,min}''$ and $P_V''=P_{V,max}''$.

If this is so, the current antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$. In this case, no control signal U_{ST} is generated since no change in the antenna length l_{ANT} is necessary.

If this is not so, the processor µP first generates a first control signal U_{ST} so that the adjusting device (VM) telescopes out the antenna. The input signals

P_V'', P_R'' present at the processor which are changed by this process are checked by the processor µP with respect to the ideal values to be reached.

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If the values of the signals P_V'', P_R'' have deteriorated with regard to reaching the ideal values, the direction of rotation of the means (VM) for adjusting the antenna length l_{ANT} is changed. This is achieved, for example, by reversing the sign of the signal U_{ST}.

Following the determination of the correct direction, the signal U_{ST} is generated until the input signals P_V'', P_R'' have reached their ideal values.

As an alternative, any one of the two variables - forward transmit power P_V and return transmit power P_R - can also be used as control variable for this servo loop, i.e. detected by the means EFM and checked by the processor μP whether it has reached the ideal values - minimum or no return transmit power or maximum forward transmit power.

As an alternative to using an additional processor μP, it would be conceivable that pre-existing processors are updated by suitable control software in order to be able to perform this control operation.

If an additional processor μP is used, it would also be conceivable to integrate the means EFM in the processor μP.

The radio transceiver device SE shown in figure 4 again exhibits the means EFM for detecting the current antenna impedance Z_{ANT} of the antenna ANT.

For this purpose, the means EFM are constructed as Wheatstone resistance measuring bridge, with a reference resistor R0=50Ω, two resistors R1, R2 having the same resistance value, the antenna impedance Z_{ANT} as variable quantity and a source (G_{NOISE}) for generating

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noise, for example implemented by a diode connected to a direct-voltage source. A current bridge voltage U_{BR} present at terminals KL

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is first rectified by a rectifier and the rectified voltage U_{BR}' is converted into a digital signal U_{BR}'' by means of an analog/digital converter AD3.

The signal U_{BR}'' is forwarded to a control unit μP which, when a signal is present, starts to control the antenna length l_{ANT}, which operation is ended when the signal U_{BR}'' is at a minimum or, respectively, $U_{BR}''=0$ is true. In this case, the antenna length l_{ANT} meets the condition $l_{ANT}=\lambda/4$.

The antenna length l_{ANT} is changed by the adapting device VM, the direction of the antenna length l_{ANT} - i.e. whether the antenna is to be retracted or telescoped out - being determined analogously to the previous exemplary embodiment.

As an alternative, it is conceivable to construct the control unit μP as switchgear and to implement it as an integrated circuit in a special expansion chip.

A first exemplary embodiment of the invention is obtained by combining figures 1 and 3, a second exemplary embodiment is obtained from figures 1 and 4, a third exemplary embodiment is obtained from figures 2 and 3 and a fourth one from figures 2 and 4.

The said four exemplary embodiments only represent a part of the embodiments possible by means of the invention. Thus an expert active in this field is capable of creating a multiplicity of further embodiments by means of advantageous modifications without changing the character (nature) of the invention by this means. These embodiments are also intended to be covered by the invention.

Patent Claims

1. A mobile radio transceiver device (SE) having the following features;

a) an antenna (ANT) for transmitting radio signals (SIG) of different wavelength (λ), the length of which is variable,

b) means (VM) for adjusting the antenna length (l_{ANT}),

c) means (EFM) for detecting at least one physical input variable (EG) representing a function of the antenna length (l_{ANT}),

d) a control device (μP) connected to the detection means (EFM), which controls the adjusting means (VM) by means of at least one control signal (U_{ST}) in dependence on the input variable (EG) or on the input variables (EG) until the antenna length (l_{ANT}) is adjusted to one quarter of the wavelength (λ) by means of the adjusting means (VM),

e) the control unit (μP) is constructed in such a manner that it adjusts the antenna length (l_{ANT}) to a minimum value ($l_{ANT,\ min}$) at the beginning of the adjustment of the antenna length (l_{ANT}).

2. The mobile radio transceiver device (SE) as claimed in claim 1, characterized in that

a) the detection means (EFM) exhibit a directional coupler (RK) for measuring a forward transmit power (P_V) and/or return transmit power (P_R) of a transmit signal (SIG),

b) the detection means (EFM) are equipped, for rectifying the values of the forward transmit power (P_V) and/or return transmit power (P_R), measured by the directional coupler (RK), with at least one rectifier (G1, G2) which generates a rectified forward transmit power (P_V') and/or a rectified return transmit power (P_R'),

c) the detection means (EFM) exhibit, for digital conversion of the rectified values of the forward transmit power (P_V') and/or return transmit power (P_R'), at least one A/D converter (AD1, AD2) which [lacuna] a digitally converted forward transmit power (P_V'') and/or a digitally converted return transmit power (P_R''),

d) the control device (μP) reads in the digitally converted values of the forward transmit power (P_V'') and/or return transmit power (P_R'') as input signals and generates the control signal (U_{ST}) dependent thereupon until the value of the digitally converted forward transmit power (P_V'') is at a maximum and/or the value of the digitally converted return transmit power (P_R'') is at a minimum.

3. The mobile radio transceiver device (SE) as claimed in claim 1, characterized in that

a) the detection means (EFM) exhibit a Wheatstone measuring bridge (WM) which generates a bridge voltage (U_{BR}) which is proportional to an impedance (Z_{ANT}) of the antenna (ANT1, ANT2),

b) the detection means (EFM) exhibit a noise generator (G_{NOISE}) which is used as input signal source for the Wheatstone measuring bridge (WM),

c) the detection means (EFM) are equipped with a rectifier (G3) for rectifying the bridge voltage (U_{BR}) of the Wheatstone measuring bridge (WM), which generates a rectified bridge voltage (U_{BR}'),

d) the detection means (EFM) exhibit, for digital conversion of the rectified value of the bridge voltage (U_{BR}') of the Wheatstone measuring bridge (WM), an A/D converter (AD3) which generates a digitally converted bridge voltage (U_{BR}'),

e) the control unit (μP), which reads in the digitally converted value of the bridge voltage (U_{BR}'') of the Wheatstone measuring bridge (WM) as input signal, generates a control

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signal (U_{ST}) dependent thereupon until the Wheatstone measuring bridge (WM) is calibrated.

4. The mobile radio transceiver device (SE) as claimed in one of the preceding claims, characterized in that

a) the antenna (ANT) is a telescopic antenna (ANT1) to which an electrically non-conductive wire (D1) is attached on the inside at the antenna point,

b) the adjusting means (VM) exhibit an electrically non-conductive coil former (SP1) on which the electrically non-conductive wire (D1) is wound,

c) the electrically non-conductive wire (D1) is of such a nature that it converts the rotational movement of the coil former (SP1) into a straight-line movement in order to retract and/or telescope out the telescopic segments of the telescopic antenna (ANT1).

5. The mobile radio transceiver device (SE) as claimed in claim 4, characterized in that the telescopic antenna (ANT1) is equipped, for supporting the wire (D1) for telescoping out the telescopic antenna (ANT1), with a spring which presses all telescopic segments of the telescopic antenna (ANT1) outward so that the telescopic antenna (ANT1) is completely telescoped out.

6. The mobile radio transceiver device (SE) as claimed in one of claims 1 to 3, characterized in that

a) the adjusting means (VM) exhibit an electrically conductive coil former (SP2) on which an electrically conductive wire (D2), electrically conductively connected to the coil former (SP2), is wound,

b) the electrically conductive wire (D2) is of such a nature that it converts a rotational movement of the coil former (SP2) guided by an electrically non-conductive hollow body (H) into a straight-line movement,

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c) the antenna (ANT) is constructed as wire antenna (ANT2) which is composed of the telescoped-out wire (D2) and the electrically conductively connected coil former (SP2), a connection of the wire antenna (ANT2) being achieved via an electrically conductive sliding contact (SK) which contacts the coil former (SP2) at the base.

7. The mobile radio transceiver device (SE) as claimed in one of claims 1 to 3, characterized in that

a) the adjusting means (VM) exhibit an electrically conductive coil former (SP2) on which an electrically conductive wire (D2), electrically conductively connected to the coil former (SP2), is wound,

b) the electrically conductive wire (D2) is of such a nature that it converts a rotational movement of the coil former (SP2) guided by an electrically non-conductive hollow body (H) into a straight-line movement,

c) the antenna (ANT) is constructed as wire antenna (ANT2) which is composed of the telescoped-out wire (D2) and the electrically conductively connected coil former (SP2), a connection of the wire antenna (ANT2) being achieved via an electrically conductive sliding contact (SK) which contacts the wire (D2) wound onto the coil former (SP2) at the base.

8. The mobile radio transceiver device (SE) as claimed in one of the preceding claims, characterized in that the adjusting device (VM) is an electric motor.

9. The mobile radio transceiver device (SE) as claimed in claim 8, characterized in that the electric motor is a stepping motor.

10. The mobile radio transceiver device (SE) as claimed in one of the preceding claims, characterized in that the control unit (μP) is a processor with software designed for generating the control signal (U_{ST}) or, respectively, the control signals (U_{ST}).

11. The mobile radio transceiver device (SE) as claimed in one of claims 1 to 9, characterized in that the control unit (μP) is constructed as switchgear.

12. The mobile radio transceiver device (SE) as claimed in claim 4, characterized in that the electrically non-conductive wire (D1) is constructed as a nylon wire.

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Abstract

Mobile radio transceiver device with tuneable antenna

To implement a transmitting/receiving capability in different frequency ranges by means of radio transceiver devices SE which guarantee a uniformly stable antenna gain, the radio transceiver devices SE are equipped with an antenna ANT, the length l_{ANT} of which is adjustable, the antenna length l_{ANT} being changed by means of adjusting means VM controlled by means of a control device μP. The control device μP controls the adjusting means VM in dependence on physical input variables EG representing the antenna length l_{ANT} until the antenna length l_{ANT} corresponds to one quarter of the wavelength λ.

FIGURE 3

Fotokopie

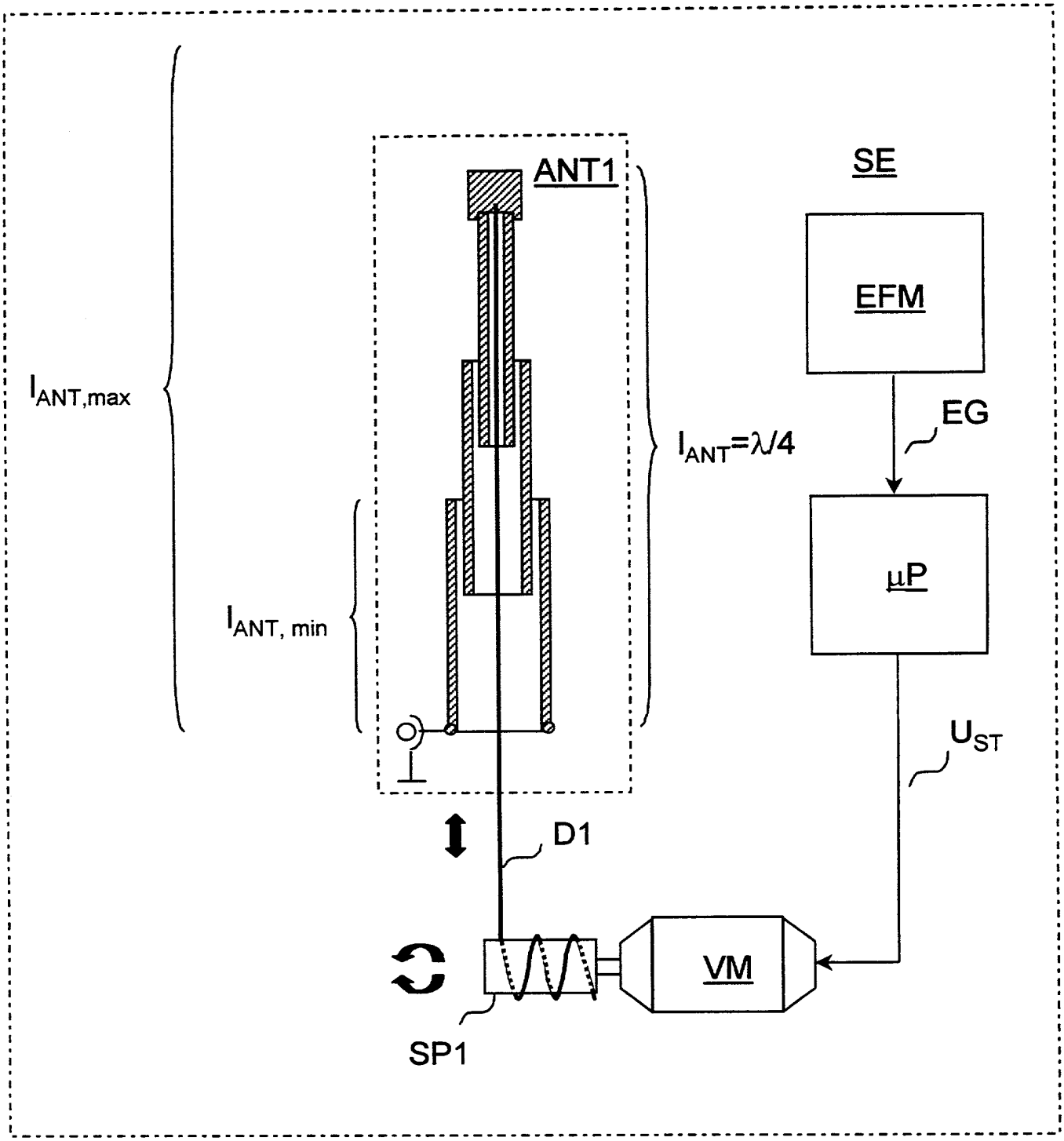

FIG 1

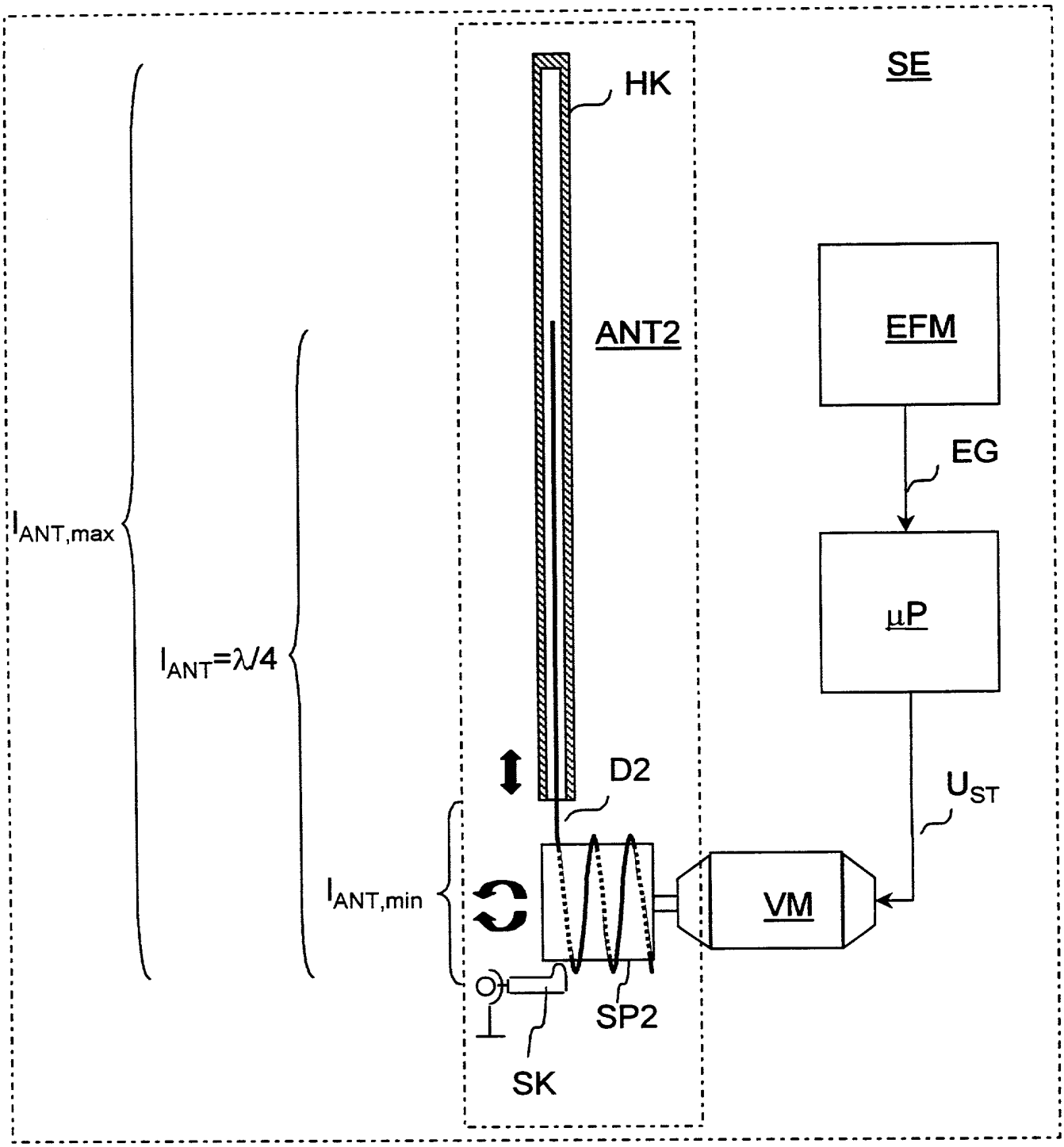
SE
HK
ANT2
EFM
EG
µP
U_{ST}
D2
VM
SP2
SK
$l_{ANT,max}$
$l_{ANT}=\lambda/4$
$l_{ANT,min}$

FIG 2

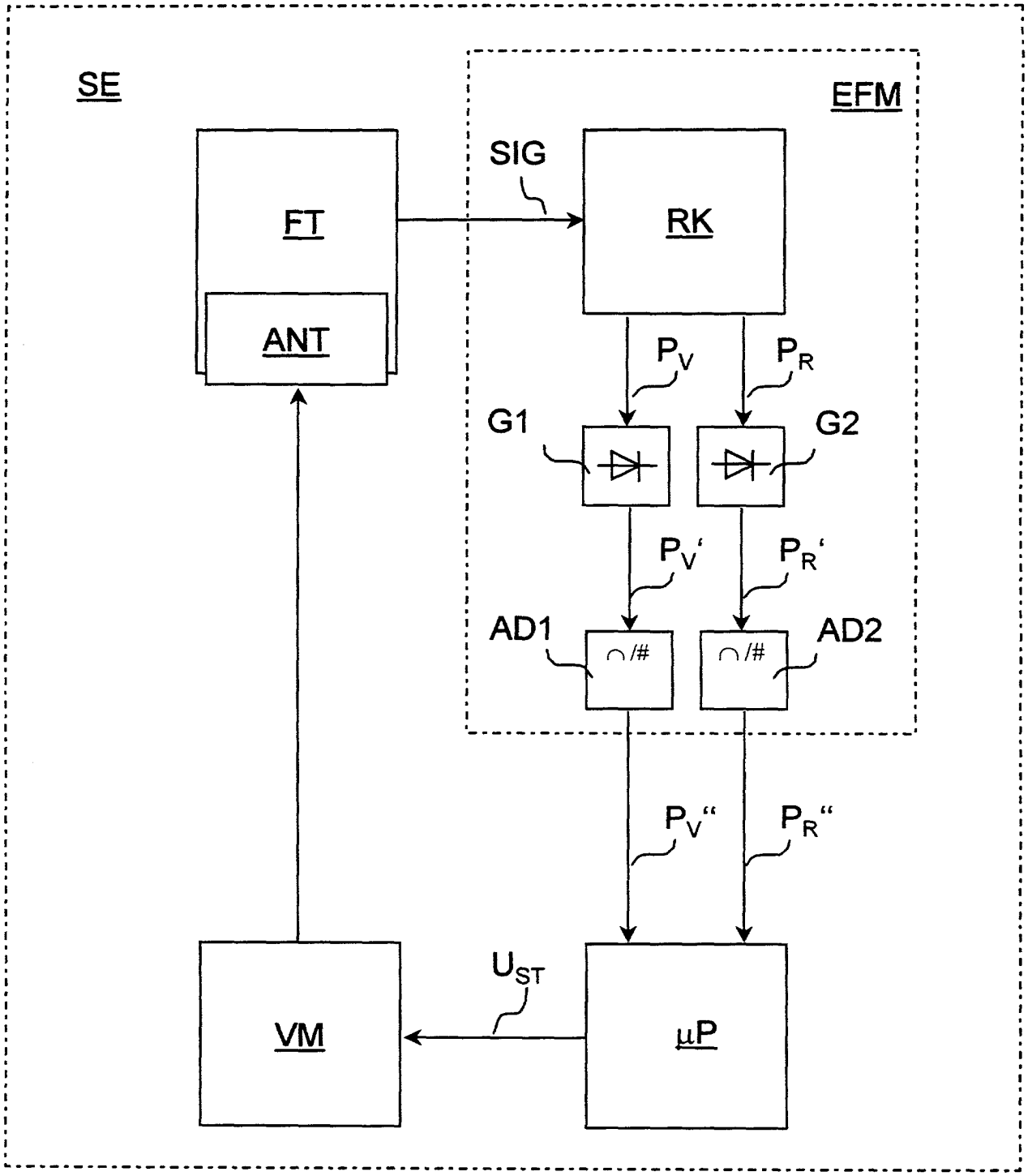

FIG 3

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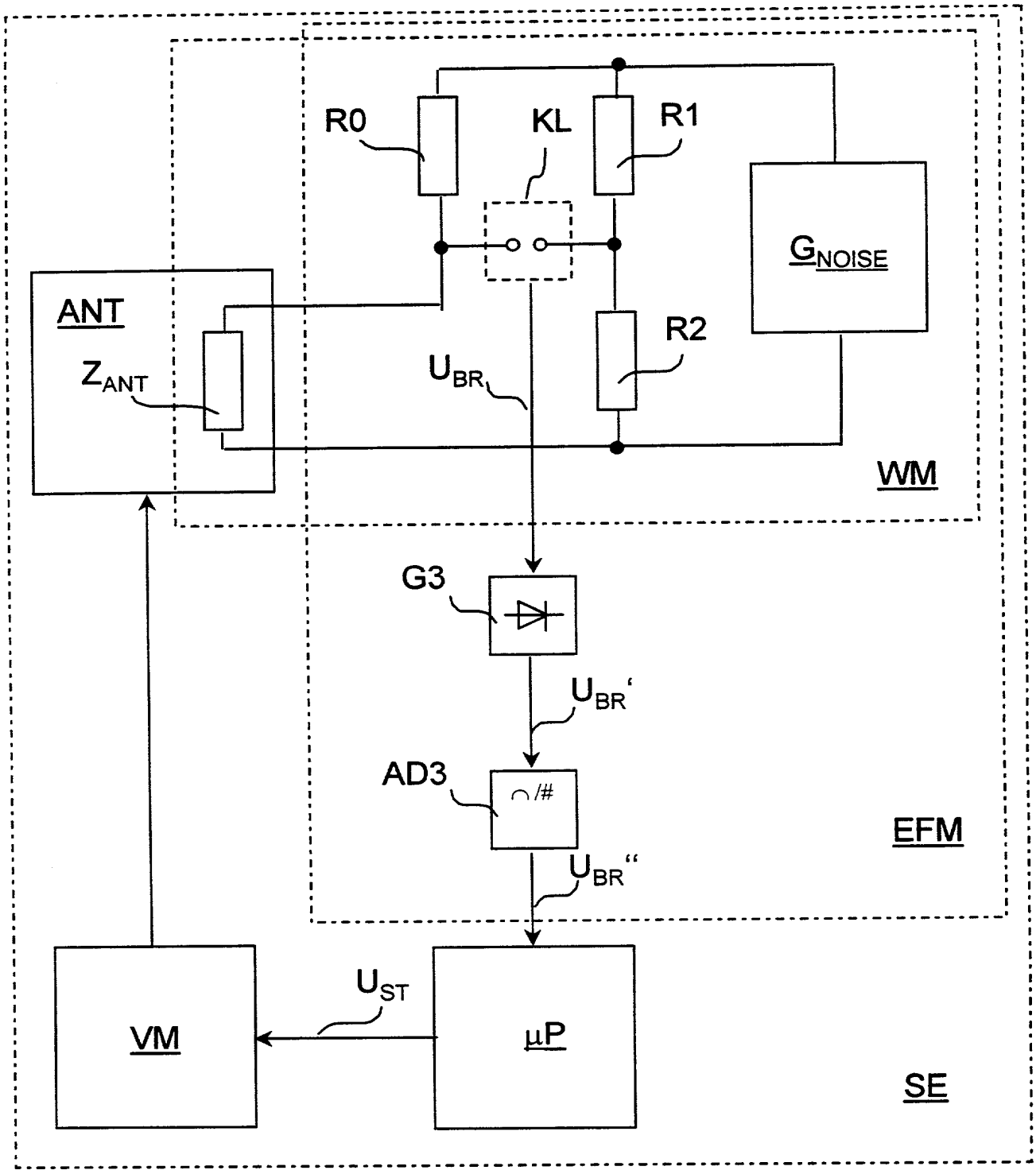

FIG 4

Form 2051 - 7/95 - EPO

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Erklärung Für Patentanmeldungen Mit Vollmacht
German Language Declaration

Als nachstehend benannter Erfinder erkläre ich hiermit an Eides Statt:

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Mobile Funk-Sende-/Funk-Empfangseinrichtung mit abstimmbarer Antenne

deren Beschreibung

(zutreffendes ankreuzen)
☐ hier beigefügt ist.
☐ am 20.04.2000 als
PCT internationale Anmeldung
PCT Anmeldungsnummer PCT/DE00/01248
eingereicht wurde und am _____
abgeändert wurde (falls tatsächlich abgeändert).

Ich bestätige hiermit, dass ich den Inhalt der obigen Patentanmeldung einschliesslich der Ansprüche durchgesehen und verstanden habe, die eventuell durch einen Zusatzantrag wie oben erwähnt abgeändert wurde.

Ich erkenne meine Pflicht zur Offenbarung irgendwelcher Informationen, die für die Prüfung der vorliegenden Anmeldung in Einklang mit Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) von Wichtigkeit sind, an.

Ich beanspruche hiermit ausländische Prioritätsvorteile gemäss Abschnitt 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 119 aller unten angegebenen Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde, und habe auch alle Auslandsanmeldungen für ein Patent oder eine Erfindersurkunde nachstehend gekennzeichnet, die ein Anmeldedatum haben, das vor dem Anmeldedatum der Anmeldung liegt, für die Priorität beansprucht wird.

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Mobile radio transmitting-receiving device comprising a tunable antenna

the specification of which

(check one)
☐ is attached hereto.
☐ was filed on 20.04.2000 as
PCT international application
PCT Application No. PCT/DE00/01248
and was amended on _____
(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Printed: 15.05.2000

IDNR: 2590 / V: 99-1.00 / B:Val

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Prior foreign appplications
Priorität beansprucht

			Priority Claimed	
19919107.7	DE	27.04.1999	☒	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein
			☐	☐
(Number)	(Country)	(Day Month Year Filed)	Yes	No
(Nummer)	(Land)	(Tag Monat Jahr eingereicht)	Ja	Nein

Ich beanspruche hiermit gemäss Absatz 35 der Zivilprozessordnung der Vereinigten Staaten, Paragraph 120, den Vorzug aller unten aufgeführten Anmeldungen und falls der Gegenstand aus jedem Anspruch dieser Anmeldung nicht in einer früheren amerikanischen Patentanmeldung laut dem ersten Paragraphen des Absatzes 35 der Zivilprozeßordnung der Vereinigten Staaten, Paragraph 122 offenbart ist, erkenne ich gemäss Absatz 37, Bundesgesetzbuch, Paragraph 1.56(a) meine Pflicht zur Offenbarung von Informationen an, die zwischen dem Anmeldedatum der früheren Anmeldung und dem nationalen oder PCT internationalen Anmeldedatum dieser Anmeldung bekannt geworden sind.

I hereby claim the benefit under Title 35. United States Code. §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §122, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occured between the filing date of the prior application and the national or PCT international filing date of this application.

PCT/DE00/01248	20.04.2000	anhängig	pending
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D, M, Y) (Anmeldedatum T, M, J)	(Status) (patentiert, anhängig, aufgegeben)	(Status) (patented, pending, abandoned)
(Application Serial No.) (Anmeldeseriennummer)	(Filing Date D,M,Y) (Anmeldedatum T, M; J)	(Status) (patentiert, anhängig, aufgeben)	(Status) (patented, pending, abandoned)

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German Language Declaration

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Voller Name des einzigen oder ursprünglichen Erfinders:	Full name of sole or first inventor:
VOLKER DETERING 1-00	VOLKER DETERING
Unterschrift des Erfinders Datum: Volker Detering 07.03.01	Inventor's signature Date
Wohnsitz: EMMERICH, DEUTSCHLAND	Residence: EMMERICH, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: GROENDAHLSCHER WEG 20 46446 EMMERICH	Post Office Addess: GROENDAHLSCHER WEG 20 46446 EMMERICH
Voller Name des zweiten Miterfinders (falls zutreffend): DIETMAR GAPSKI 2-00	Full name of second joint inventor, if any: DIETMAR GAPSKI
Unterschrift des Erfinders Datum: 7.9.2001	Second Inventor's signature Date
Wohnsitz: BOCHOLT, DEUTSCHLAND	Residence: BOCHOLT, GERMANY DEX
Staatsangehörigkeit: DE	Citizenship: DE
Postanschrift: IM OSTERESCH 25 46397 BOCHOLT	Post Office Address: IM OSTERESCH 25 46397 BOCHOLT

(Bitte entsprechende Informationen und Unterschriften im Falle von dritten und weiteren Miterfindern angeben).

(Supply similar information and signature for third and subsequent joint inventors).

Docket: P2000,5366